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EDUCATION

This department publishes articles, notices, and news on programs and courses in history of mathematics, the uses of history in mathematics education, historical activities at meetings of mathematics teachers, and other matters relating to the place of our discipline in academic affairs.

MATHEMATICAL IDEAS IN NON-WESTERN CULTURES

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All too often mathematical ideas from other cultures--ancient, nonliterate, or, in general, non-Western--are presented as curiosities or as motivational devices. Under the erroneous assumption that the necessary direction of ideas is Western, the ideas of others are made overly simple or they are made to seem a historically earlier part of our own mathematics. Instead, the assumption of this course is that mathematics is a pan-human endeavor that does not necessarily form one unilinear stream. The ideas of others are studied for what we can learn about them; we avoid judgments such as simple/complex or other inherently prejudicial notions. However, just as anthropologists must make recourse to their own cultural framework in order to describe another culture, Western categories and terminology are used here as a necessary framework for discussion.

The major ideas emphasized in this course are those related to number, spatial configuration, and logic. If a culture has no professional class of mathematicians, mathematical ideas may be implicit or informal. Ideas arising in different cultural contexts are evidenced in different ways and, to be appreciated, cannot be divorced from their contexts. For example, in our culture, concepts of chance are often embedded in games involving personal gain or loss; in other cultures, similar concepts are found in divination ceremonies or in some healing rituals. In all cases, there are rules regarding the surrounding circumstances, the permitted participants, and the materials used, as well as values assigned to particular outcomes. The students taking this course should learn to view mathematics broadly and to appreciate the varied roles it has played in peoples' lives.

Although the course has no formal prerequisites, it is designed for students who have completed at least one year of college work. In order to accommodate the varied levels of mathematical and cultural sophistication, the class is limited to fifteen students.

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COURSE OUTLINE

The course is divided into two major parts. Throughout the first part, which develops diverse topics, selected readings are assigned from [Zaslavsky 1973], and students are asked to do problem sets associated with each of the topics. At the conclusion of the study of symmetry and geometric patterns, a three-week project is assigned. Each student is asked to find five strip patterns from another culture and to write a paper which includes symmetry analysis of them, as well as their cultural and material contexts. At the conclusion of the study of games of chance, a second, lengthier project is assigned. Each student is asked to investigate a game from another culture through library research, as well as through several hours of actual play.

The second part of the course focuses on the integration of ideas within specific cultures or regions. The assigned readings are consecutive complete chapters of [Ascher & Ascher 1981], and then of [Childe 1951]. The class sessions depend directly on the reading. Also, [Ascher & Ascher 1981] contains problems to be worked by the reader. The portion of the outline dealing with the second part of the course therefore notes the specific readings and contains less detail.

I. *Introduction*

The pan-human nature of mathematical ideas; implicit and explicit mathematics; cautions about cultural assumptions. (1 hour)

II. *Diverse Topics*

1. *Kin Logic*: American kin terms analyzed for some properties of relationships (symmetry, transitivity, inverse); a native Australian set of marriage rules and some logical implications. (1-2 hours)

2. *Number Words*: Implied bases; implied multiplication, addition and subtraction; different sets of words for different categories of objects; relationship of words to finger and body counting. (1-2 hours)

Some references: [Closs 1977, Eells 1913, Hurford 1975, Seidenberg 1960].

3. *Symmetry and Geometric Patterns*: Groups; Abelian groups; the dihedral group of the square and of the equilaterial triangle; strip patterns and the frieze symmetry groups including generation and analysis with examples primarily drawn from the Bakuba and Benin; analysis as a way of gaining insight into construction processes and pattern types characteristic of a culture; results of some analyses of native American and Inca strip pat-

terns; brief mention of plane symmetry groups and works of Western mathematicians and crystallographers. (5 hours)

Some references: [Crowe 1971, 1975, Schattschneider 1978, Shepard 1948].

4. *Magic Squares*: General, symmetric, diabolic; historical dispersion; Western mystical associations; Western continuity of interest in the numerical arrays devoid of magical associations; the writings of Muhammad ibn Muhammad; De la Loubère's generating technique; using the dihedral group of squares to generate others; associated Chinese beliefs; the magic cube and magic circle; harmony seen in odd/even patterns and center balance; the Giant Lo-Shu and the embedded Lo-Shus. (4 hours)

Some references: [Ball 1963, Cammann 1963, Needham 1959].

5. *Graphs and Mazes*: Traversing continuous closed paths without retracing any segment; a Shongo children's game; the Königsberg bridge problem; Euler's theorem; connectedness; planar graphs; isomorphic graphs; the Malekula myth and associated figures; simplifying traversing paths by identifying symmetry, closed loops and paired edges; the myth of the labyrinth of Knossos; European turf labyrinths, hedge mazes and church floor mosaics; converting mazes and labyrinths to graphs; escaping from mazes; Tarry's theorem. (6 hours)

Some references: [Biggs et al. 1976, Deacon 1934, Matthews 1922].

6. *Games of Chance*: Simple probability, expected value, fair game; tree diagrams and successive trials; early dice; forerunners of dice and divination; the native American game of dish; a native American stone circle game; scoring and implicit probability; rule variations and the effects on expected length of play. (4 hours)

Some references: [Culin 1907, David 1962].

III. *Ideas within Specific Cultures and Regions*

1. *African Regional Studies*: Southwest Nigéria and East Africa.

Reading: [Zaslavsky 1973, Chaps. 20-24. (1-2 hours)

2. *The Inca Quipu*: Inca culture; how to make a quipu (physical parts, color system, number representation, number labels); the place of the quipu and the quipumaker in Inca society; quipi configurations; cross categorization; charts, subcharts and sum-charts; hierarchical categorization; charts of data trees; patterned number labels; arithmetic and recurrent numbers; the quipu placed among other human ideational endeavors.

Reading: [Ascher & Ascher 1981, Chaps. 1-9]. (12 hours)

3. *Revolutions in Human Knowledge and the Emergence of Civilization in the Near East*: Early phases of cultural evolution; time scales for viewing human history; the agricultural revolution; the beginning of cities; the recording of human knowledge; some details of Egyptian papyrii.

Reading: [Childe 1951, Preface, Chaps. 1-9]. (Note: an addendum correcting the chronology and noting newer evidence is distributed. The book remains, however, the classic work on the growth of technological thought in pre-literate and early-literate contexts.) (4 hours)

Some references: [Gillings 1972, Neugebauer 1962].

IV. *Divisions of Time and Calendars*

Natural divisions and cycles; formalizations of time divisions; Mohammedan calendar; Jewish calendar; Julian/Gregorian calendar; Maya numerals, Maya calendar. (4-5 hours)

Some references: [Closs 1977, Land 1963, Richmond 1956, Zinberg 1963].

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